Remediation of soils contaminated with Uranium by soil washing process

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Laboratory bench-scale soil washing experiments were performed to remove uranium from a contaminated sandy soil. The contaminated soil samples were collected around the ricefield (its bedrock is the black shale) in Duckpyong-ri, Korea. The contaminated soil sample was extracted by using the weak and the strong acid solution (aqua regia) to determine its uranium concentration was 35.824 mg/kg and 157.560 mg/kg, respectively. From the result of synthetic precipitation leaching procedure (SPLP), the uranium concentration of leaching solution was 56.821 ug/L, which exceeded the USEPA Water Quality Standard Limit (30 ug/L). To remove uranium from the soil, the soil washing experiments with different washing conditions were duplicated. The uranium removal efficiency of washing solution according to various pH condition of solution (pH 1-12) was also investigated. Finally, various washing solutions adding reactants such as hydrochloric acid, sulfuric acid, acetic acid, citric acid, and EDTA were used to maximize the uranium removal efficiencies from the uranium contaminated soil. Different washing times (30 min, 1hr, and 2hr) and various soil : solution ratios (1:1, 1:3, and 1:5) were applied for the experiment. Reactant concentration was applied in the experiment to find out the optimum amount of reactant the soil washing process. From results of soil washing experiments using various pH conditions of washing solution, the uranium removal efficiency was over about 79 % with strong acidic (pH 1) solution. However, at pH 2-12 of washing solution, the uranium removal efficiency of soil washing maintained around 0-10 %. The removal efficiency of strong acidic washing solution such as 0.05 M sulfuric acid and 0.1 M hydrochloric acid was very high (up to 100 % and 91 %). In case of soil washing experiment at different washing time, the removal efficiency of uranium was 79.60 % within 30min of washing time. When washing times were applied at 1hr and 2hr, the uranium removal efficiencies were 76.22 % and 67.23 %, respectively. Results of the experiments suggested that the soil washing process is very useful to remediate the uranium contaminated soil.

Sequestration mechanisms and sources of Rhenium in lacustrine sediments, Eastern Canada

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The concentrations of Re, as well as those of several other geochemical variables, were measured in dated sediment cores and in porewater samples from four lacustrine basins in Eastern Canada: one, perennially oxic, located 40 km from Québec City and three, seasonally anoxic, located within 25 km of non-ferrous metal smelters. The drainage basins of these lakes are uninhabited and have not been affected by human activity or wildfires. All of the depth profiles of dissolved Re indicate: higher Re concentrations in the water overlying the sediment than in the porewater; diffusion of Re across the sediment-water interface; a progressive decrease in porewater Re concentrations to reach minimum values within a 10-cm sediment depth interval. Modeling of these Re porewater profiles with a one-dimensional transport-reaction equation indicates that Re is removed from porewater within this depth interval. Based on thermodynamic predictions of Re speciation and of saturation states and on comparison of these predictions with sulfide porewater profiles, we infer that Re is removed from porewater by precipitation of rheniite ($ReS_{2(s)}$). The rate constant for the formation of $ReS_{2(s)}$ in sediments is estimated from the modeling exercise to be $0.5\pm0.6 \times 10^{-21}$ mol cm^{-3} s^{-1}. Since Re immobilization in the sediments involves dissolved sulfide, such a process cannot occur in sub-oxic environments, as previously proposed. Accumulation of sedimentary Re shows a strong authigenic component, as in anoxic marine sediments. Sharp increases in solid-phase Re during the last century are attributed to atmospheric deposition of anthropogenic Re deriving from coal burning and the nearby smelters emissions.